

**MODIS/Snow Project  
Quarterly Report (8 October 1993)  
Submitted by D.K. Hall/974**

## **Data Analysis**

Analysis continued on the snow-mapping algorithm (SNOMAP) that has been developed using thresholding approaches on TM data. A digital elevation model was applied to a glacierized/snow-covered scene of Glacier Bay, Alaska, and SNOMAP will be run on that scene. Analysis has also been ongoing to study the utility of NOAA/AVHRR and SSMI/passive microwave data for use in concert with future MODIS data in order to map snow cover, depth and albedo.

An algorithm for the identification of snow cover using TM data has been developed and refined. A scene from the Sierra Nevadas was acquired from Walter Rosenthal/UCSB. Rosenthal applied an algorithm and ground truth to the mapping of that particular scene and determined that the accuracy of his map was nearly 100 percent. Our algorithm was applied to that scene with an accuracy exceeding 95 percent. We have also tested our algorithm on other scenes, though the other scenes lack ground truth. The scenes include Chugach Mountains, Alaska, Glacier National Park, Montana and a scene in northern Minnesota. Results show a good correspondence of snow-covered area determination using our algorithm, with a possible miscalculation in agricultural areas with very light snowfall in agricultural areas, and areas of dense forests, both occurring in the Minnesota scene.

Glacier Bay, Alaska is the site of major deglaciation and is quite well documented on Landsat imagery. TM scenes of Glacier Bay have been acquired and processed in order to study scene-reflectance changes relating to revegetation and deglaciation, and to map changes in glacier-terminus positions, and to map the snow and ice using SNOMAP. DEM data were acquired from the Eros Data Center and registered to the 1986 TM scene. SNOMAP will be applied to the scene in the next few weeks.

Combining DEM, AVHRR, SSMI and forest-cover data over the State of Alaska has led to some preliminary findings. Results show that passive microwave brightness temperature is clearly

influenced by snow temperature which decreases at higher elevations, and by the presence of forest cover. On-going analysis of a time series of AVHRR data will reveal the percentage of cloud-free weekly-average scenes that we can expect with MODIS. We have been working with the MODIS SDST to process and register AVHRR data over the Northern Hemisphere in the winter using Pathfinder data.

#### Plans for Field Work in the winter of 1994

There are two field trips planned for early 1994. The first is primarily a lake-ice experiment to be held for the fourth year in Glacier National Park, Montana. However, there will be time if weather permits to undertake some measurements of snow reflectance, in support of the MODIS project, with a new spectrometer borrowed from the Biospheric Sciences Branch. While no concurrent aircraft measurements will be acquired, an attempt will be made to coordinate this activity with a Landsat overpass thus enabling a comparison of field and aircraft-acquired reflectance measurements. This will also present an opportunity to test the spectrometer prior to use in the BOREAS experiment to be held in February.

During the month of February 1994, the winter phase of the BOREAS experiment will be held in Prince Albert National Park, Saskatchewan. MODLAND has an approved BOREAS project. The MODIS snow project will collaborate with other BOREAS experiments to obtain data using the MODIS Airborne Simulator (MAS), passive microwave instruments and gamma-ray sensors to measure snow extent, reflectance and depth. The utility of the MAS to map snow in heavy forest cover will be investigated concurrent with the ability of the passive microwave sensors to map both snow extent and depth through dense forests. Meetings have been held with the Canadians and other BOREAS investigators to plan the winter experiment.

The next BOREAS planning meeting will be held at the Coolfont in Berkeley Springs, West Virginia during the week of October 18. S. Running, V. Vanderbilt and D. Hall of MODLAND will attend.

#### MODIS Airborne Simulator Flights

During test flights of the ER-2, data sets were acquired for the snow project using the MAS. In March of 1992, and again in 1993 our test site in the snow-covered Sierra Nevadas was overflown. The 1992 data were processed and distributed to us by the MODIS Science Data Support Team. Though analysis was begun, SDST has recently indicated that the data set needs to be re-calibrated and the newly-calibrated data will be redistributed at a later date.

### **ASAS Data Analysis**

ASAS data that was collected in February 1992 has been under analysis. However, due to the need to develop the ATBD and the snow-cover mapping algorithm before the snow reflectance algorithm, the ASAS analysis has been given second priority. Dave Diner of the MISR team requested ASAS data acquired by Jim Irons/923 for us over Glacier National Park in February 1992. Diner has registered the data from the various angles acquired by the ASAS because ASAS data can sometimes be a good surrogate for MISR data. Plans were discussed at the last MODIS Team Meeting to collaborate with Diner on the analysis of the February 1992 ASAS data.

### **Algorithm Theoretical Basis Document**

During the past quarter, the snow project has spent much time developing the ATBD for the snow and sea ice products. Version 1 of this document is available through MODARCH.